HIMatrix

Safety-Related Controller

Maintenance Manual

HIMA Paul Hildebrandt GmbH + Co KG

Industrial Automation

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For further information, refer to the HIMA DVD and our website http://www.hima.de and http://www.hima.com.

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Table of Contents

1 Introduction

This document describes the most important activities for servicing and operating safety-related HIMatrix controllers.

- Chapter 2 provides two tables: one with the activities required for the HIMatrix compact systems and one with those required for the HIMatrix modular systems.
- Chapter 3 specifies the relevant manuals and other applicable documents.
- Chapter 4 describes the proof test.
- Chapter 5 describes in detail the required maintenance actions and provides references to further documents.

2   Operating and Servicing

The activities required for compact differ from those required for modular systems.

2.1   Compact Systems F1..., F2..., F3...

No.	Action	Period	Reference (Table 3)	Performed by [1]	Notes
1	Access protection (security)	Always	-	A	
Mechanical test (visual inspection)					
2	Have the devices snapped into position on the DIN rail?	Yearly	-	C, A, O	
Power supply test					
3	Check 230 VAC/24 VDC	Yearly	-	C, A, O	
4	Check 24 VDC distribution	Yearly	-	C, A, O	
5	Functionality with redundant supply	Yearly	-	C, A, O	
Proof Test					
6	Loop test including the I/O modules within the PES	≤ 10 years	D3 Chapter 4	C, A, O	
	Compact devices with relay	≤ 3 years			
	The modules used for safety-related application must be subjected to a proof test at regular intervals (refer to IEC/EN 61508-4, Section 3.8.5)				
Hardware change/extension/test					
7	Replacement of compact devices	If required	D2 Chapter 5.1.2	C, A, O	
8	Replacement of the fan with F20		D7 Chapter 5.1.1	H, (C, A, O)	
	At an operating temperature of ≤ 40 °C	Every 5 years			
	At an operating temperature of > 40 °C	Every 3 years			
9	Replacement of the buffer batteries	Every 4 years		H	For controllers with previous layouts only
Software change/extension/test					
10	Load and deletion of the user program	If required	D3	C, A, O	
11	Operating system download	If required	D3	C, A, O	
12	Change of the system parameter settings	If required	D2, D7 D4 or D5	C, A, O	
[1] C: operating Company, A: Assembler, O: Other, H: HIMA					

Table 1:   Operating and Maintenance Activities Required for Compact Systems

Only personnel with knowledge of ESD protective measures may modify or extend the system or replace devices.

NOTE
Device damage due to electrostatic discharge! • **When performing the work, make sure that the workspace is free of static, and wear an ESD wrist strap.** • **If not used, ensure that the device is protected from electrostatic discharge, e.g., by storing it in its packaging.**

2.2 F60 Modular Systems

No.	Action	Period	Reference (Table 3)	Per-formed by [1]	Notes
1	Access protection (security)	Always	-	A	
Mechanical test (visual inspection)					
2	Are the modules screwed tightly?	Yearly	-	C, A, O	
3	Are the data connection cables screwed tightly?	Yearly	-	C, A, O	
Power supply test					
4	Check 230 VAC/24 VDC	Yearly	-	C, A, O	
5	Check 24 VDC distribution	Yearly	-	C, A, O	
6	Functionality with redundant supply	Yearly	-	C, A, O	
Proof Test					
7	Loop test including the I/O modules within the PES	≤ 10 years	D3 Chapter 4	C, A, O	
	The modules used for safety-related application must be subjected to a proof test at regular intervals (refer to IEC/EN 61508-4, Section 3.8.5)				
Hardware change/extension/test					
8	Replacing modules	If required	D6 Chapter 5.1.2	C, A, O	Refer to the GEH 01 manual
9	Replacement of the fans		D6 Chapter 5.1	C, A, O	
	At an operating temperature of ≤ 40 °C	Every 5 years			
	At an operating temperature of > 40 °C	Every 3 years			
11	Replacement of the back-up battery	Every 4 years	D6 Chapter 5.2.3	C, A, O	For CPU 01 modules with previous layouts only
Software change/extension/test					
12	Load and deletion of the user program	If required	D1	C, A, O	
13	Operating system download	If required	D1, D4, D5	C, A, O	
14	Change of the system parameter settings	If required	D1, D6 D4, D5	C, A, O	
[1] C: operating Company, A: Assembler, O: Other					

Table 2:   Operating and Maintenance Activities Required for Modular Systems

Only personnel with knowledge of ESD protective measures may modify or extend the system or replace modules.

NOTE

Device damage due to electrostatic discharge!
- **When performing the work, make sure that the workspace is free of static, and wear an ESD wrist strap.**
- **If not used, ensure that the device is protected from electrostatic discharge, e.g., by storing it in its packaging.**

3   Other Applicable Documents

Ref.	Standard/Document ID	Description
N1	IEC 61511-1, Section 12	Functional safety - Safety instrumented systems for the process industry sector Framework, definitions, system, hardware and software requirements
D1	HI 800 191 E	HIMatrix System Manual Modular Systems
D2	HI 800 141 E	HIMatrix System Manual Compact Systems
D3	HI 800 013 E	HIMatrix Safety Manual
D4	-	SILworX Online Help
D5	-	ELOP II Online Help
D6		Modular System manuals
	HI 800 195 E	HIMatrix AI 8 01 Module Manual
	HI 800 197 E	HIMatrix AO 8 01 Module Manual
	HI 800 199 E	HIMatrix CIO 2/4 01 Module Manual
	HI 800 189 E	HIMatrix CPU 01 Module Manual
	HI 800 201 E	HIMatrix DI 24 01 Module Manual
	HI 800 203 E	HIMatrix DI 32 01 Module Manual
	HI 800 205 E	HIMatrix DIO 24/16 01 Module Manual
	HI 800 207 E	HIMatrix GEH 01 Module Manual
	HI 800 209 E	HIMatrix MI 24 01 Module Manual
	HI 800 211 E	HIMatrix PS 01 Module Manual
D7		Compact System Manuals
	HI 800 153 E	HIMatrix F1 DI 16 01 Manual
	HI 800 155 E	HIMatrix F2 DO 4 01 Manual
	HI 800 157 E	HIMatrix F2 D O 8 01 Manual
	HI 800 159 E	HIMatrix F2 DO 16 01 Manual
	HI 800 139 E	HIMatrix F2 DO 16 02 Manual
	HI 800 161 E	HIMatrix F3 AIO 8/4 01 Manual
	HI 800 179 E	HIMatrix F3 DIO 8/8 01 Manual
	HI 800 177 E	HIMatrix F3 DIO 16/8 01 Manual
	HI 800 345 E	HIMatrix F3 DIO 20/8 02 Manual
	HI 800 143 E	HIMatrix F20 Manual
	HI 800 145 E	HIMatrix F30 Manual
	HI 800 147 E	HIMatrix F31 02 Manual
	HI 800 149 E	HIMatrix F35 Manual

Table 3:   Valid Documentation

Derived variants: Variants derived from some compact devices (the corresponding manuals are specified in Table 3) were developed for special application fields. These derived variants require the same maintenance actions valid for the basic variants.

4   Proof Test

The proof test reveals dangerous undetected faults that could otherwise affect the safe function of the system.

HIMA safety systems must be subjected to a proof test **in intervals of 10 years**. It is often possible to extend this interval using the a calculation tool to analyze the implemented safety loops.

The proof test for remote I/Os with relay outputs must be performed in intervals of 3 years.

4.1   Proof Test Execution

The proof test execution depends on the following factors:

- Plant characteristics (EUC = equipment under control)
- Plant's intrinsic risk potential
- The standards applicable to the plant operation and required for approval by the responsible test authority.

According to IEC 61508 1-7, IEC 61511 1-3, IEC 62061 and VDI/VDE 2180 sheets 1 to 4, the operator of the safety-related systems is responsible for performing the proof tests.

4.2   Frequency of Proof Tests

The HIMA PES can be proof tested by executing the full safety loop.

In practice, shorter proof test intervals (e.g., every 6 or 12 months) are required for the sensors and actuators (field devices) than for the HIMA controller. Testing the entire safety loop together with a field device automatically includes the test of the HIMA controller. There is therefore no need to perform additional proof tests of the HIMA controller.

If the proof test of the field devices does not include the HIMA controller, the HIMA controller must be tested at least once every 10 years. This can be achieved by restarting the HIMA controller.

Additional proof test requirements for specific devices or modules are described in the manual of the corresponding device or module.

4.3   Proof Test for Devices with Relay Outputs

Remote IOs and modules with relay outputs check the forcibly guided contacts of the relays during each switch operation. In this way, defects that arise are detected immediately.

For this reason, the proof test for the relays in such devices consists in triggering a switching operation, e.g., by forcing the corresponding output variable. Applications in which the relays are frequently activated during normal operation (more than once per day) do not require a proof test for the relay outputs.

5   Maintenance Actions, in Details

This chapter describes the maintenance actions for the components of the HIMatrix system.

i   Only qualified personnel may perform maintenance actions to supply, signal and data lines, taking all ESD protection measures into account. Personnel must be electrostatically discharged prior to any direct contact with these supply ore signal lines!

5.1   Compact Systems

Perform the following maintenance actions for compact modules:

- Replacement of the fan with F20
- Replacement of the devices
- Replacement of back-up battery, if existing

5.1.1   Replacement of the fan with F20

i   The fan may be replaced on site by HIMA service personnel. To do so, the controller must be switched off. The warranty is voided if the device is opened by the customer.

- Unscrew the two Torx fastening screws (**3**) located on the front side of the left and right side panels.
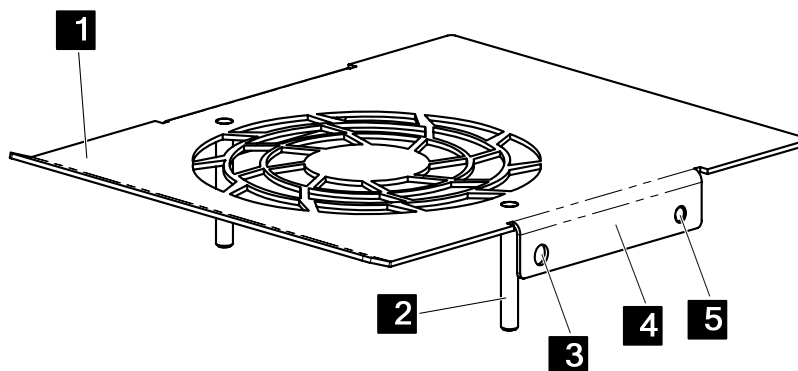

Figure 1:   F20 Cover with Guiding Pins for Fan Plate

- Use a screwdriver to lift the F20 cover (**1**) and pull it out of the blue fixture from the rear toward the front panel. At the same time, press against the fastening plate (**4**) to remove the F20 cover from the left and right hand side fixtures (**5**).
- Place the F20 cover on its coated side and unscrew the nuts from the fan's guiding pins (**2**). Use a screwdriver to apply pressure to the cable clamp latches and remove the fan's connection cables from the clamp.
- The old fan can now be replaced with a new one.

Replacement Interval
- At normal temperatures   (< 40 °C):   every 5 years
- At increased temperatures   (> 40 °C):   every 3 years

5.1.2   Replacing Compact Devices

To remove the device from the DIN rail

1. Remove all connector plugs from the device:
   - Pluggable screw terminals
   - Ethernet plugs
   - Field bus plugs, if existing
2. Insert a flathead screwdriver into the gap between the housing and the latch, using it as a lever to move the latch downward and simultaneously lift the device from the rail

The device is removed from the DIN rail.

To mount the device on the DIN rail

1. Shift the latch on the rear side of the device downwards, press it against the housing frame and snap it into position.
2. Attach the guiding rail located on the rear side of the device to the upper edge of the DIN rail.
3. Press the device against the rail and release the latch again to secure the device on the rail.
4. Insert all plugs into the correct sockets:
   - Pluggable screw terminals
   - Ethernet plugs
   - Field bus plugs, if existing/provided/used

The device is attached to the DIN rail.

5.1.3 Replacing the Back-Up Battery

A back-up battery is installed in previous layouts of the remote I/O F3 DIO 20/8 01 and of the following compact controller: F30, F31, F35. The battery is intended for storing data and operating the clock when the 24 V supply voltage has failed.

The back-up battery must be replaced every 4 years.

i	The back-up battery may only be replaced by HIMA service!

5.2 F60 Modular Systems

Modular systems may require the following maintenance actions:

- Replacement of the fans
- Replacement of the modules
- Replacement of back-up battery, if existing
- Replacement of the subrack

5.2.1 Replacing the Fans

HIMA recommends replacing the fans of the HIMatrix F60 on a regular basis to prevent the fans to fail:

- At normal temperatures (< 40 °C):   every 5 years
- At increased temperatures (> 40 °C):   every 3 years

The fans may be replaced while the controller is operating, the controller needs not be shut down.

To replace the fans located in the subrack:

1. Unscrew both fastening screws located on the left and right of the earth grid, see figure.
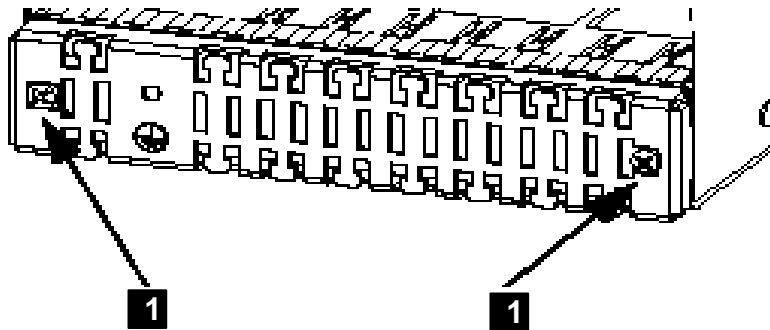
1 Fastening Screws

Figure 2:   Earth Grid with Fastening Screws

2. Position the earth grid (including the attached cables) to allow removal of the fan mounting plate located behind it.
3. Release the plugs for the fan voltage supply and remove the fan mounting plate completely.
4. Unscrew and remove the 4 fastening screws on each fan to allow replacement of the old fans.
5. Use the fastening screws to secure the new fans; in doing so, pay attention the direction of the air flow.
6. Place the mounting plate with the new fans into position and plug in the connectors for the power supply of the fans.
7. Place the earth grid into position and secure the two fastening screws.

The fans are replaced.

5.2.2   Replacing modules

NOTE

Damage to the controller possible!
Only replace the modules if the controller is shut down!

To remove a module from the subrack

1. Remove the plugs from the module front plate.
2. Release Open the locking screws located on the upper and lower extremity of the front plate.
3. Loosen the module using the handle located on the lower part of the front plate and remove it from the guiding rails.

The module is removed.

To mount a module into the subrack

1. Insert the module as far as it can go – without jamming it – into the two guiding rails which are located on the housing's upper and lower part.
2. Apply pressure to the upper and lower extremity of the front plate until the module plugs snap into the backplane socket.

3. Secure the module with the screws located on upper and lower extremity of the front plate.

4. Depending on the type of module, insert the plugs of the communication cables or field cables into the front plate.

The module is mounted.

5.2.3 Replacing the Back-Up Battery

The PS 01 power supply module is equipped with a back-up battery to store data and operate the clock when the 24 V supply voltage has failed.

> i The back-up battery is only required if the controller operates with a previous layout of the CPU 01 processor module.

> i
> - The back-up battery must be replaced every 4 years.
> - To avoid data loss, the controller must be operating while the back-up battery is being replaced.

To replace the back-up battery

1. The battery compartment cover located on the front plate is secured with two screws. Remove the screws and remove the cover.

2. The battery may be replaced without tools.

3. When installing the new battery, ensure that the proper polarity is applied. The contacts within the battery compartment must not be oxidized. Ensure that these contacts are not damaged when inserting the new battery.

The back-up battery is replaced.

5.2.4 Replacing the Subracks of F60

In very rare cases, the subrack may be faulty. If this happens, follow the steps below in the specified order to replace the subrack.

Replacing the F60 Subrack

1. Switch the voltage supply off to put the controller out of operation.

2. Remove all the modules from the subrack, see Chapter 5.1.2.

3. Remove the fans, see Chapter 5.1

4. Remove the subrack from the support, e.g., the cabinet.

5. Mount the new subrack on the support.

6. Mount the fans on the subrack, see Chapter 5.1.2.

7. Insert all modules into the new subrack, see Chapter 5.1.2.

8. Connect the voltage supply and restart the controller.

The subrack is replaced.

5.3 Loading Operating Systems

The processor and communication systems have different operating systems that are stored in the rewritable flash memories and can be replaced, if necessary.

> **NOTE**
>
> **Disruption of the safety-related operation!**
>
> **The controller must be in the STOP state to enable the programming tool to load new operating systems.**
>
> **During this time period, the operator must ensure the plant safety, e.g., by taking organizational measures.**

i
- The programming tool prevents controllers from loading the operating systems in the RUN state and reports this as such.
- Interruption or incorrect termination of the loading process has the effect that the controller is no longer functional. However, it is possible to reload operating system.

The operating system for the processor system (processor operating system) must be loaded before that for the communication system (communication operating system).

Operating systems for controllers differ from those for remote I/Os.

To be able to load a new operating system, it must be stored in a directory that can be accessed by the programming tool.

5.3.1 Loading the Operating System with SILworX

Use SILworX if the operating system version loaded in the controller is **beyond** 7**.**

To load the new operating system

1. Set the controller to the STOP state, if it has not already been done.
2. Open the online view of the hardware and log in to the controller with administrator rights.
3. Right-click the module, processor or communication module.
4. The context menu opens. Click **Maintenance/Service->Load Module Operating System**
5. In the *Load Module Operating System* dialog box, select the type of firmware that should be loaded.
6. A dialog box for selecting a file opens. Select the file with the operating system that should be loaded and click **Open**.

SILworX loads the new operating system into the controller.

5.3.2 Loading the Operating System with ELOP II Factory

Use the ELOP II Factory programming tool if the operating system version loaded in the controller is **prior to** 7.

To load the new operating system

1. Set the controller to the STOP state, if it has not already been done.
2. Log in to the controller with administrator rights.
3. In ELOP II Factory Hardware Management, right click the required resource.
4. The context menu opens. On the **Online** submenu, select **Control Panel.**
   ☑ The Control Panel opens.
5. On the **Extra** menu, **OS Update** submenu, select the type of operating system that should be loaded (processor operating system, communication operating system).
   ☑ A dialog box for selecting a file opens.
6. In this dialog box, move to the directory in which the operating system is stored and select it.

7. Click **OK** to load the operating system.

The operating system is loaded into the controller. The controller restarts and enters the STOP state.

After an operating system has been loaded, the controller also enters the STOP state if a program is loaded with the *Autostart* safety parameter set to TRUE.

The following is possible:

- Repeating the described sequence, further operating systems can be loaded, e.g., the operating system for the communication system, after the operating system for the processor system.
- The controller can be set to the RUN state.

5.3.3 Switching between ELOP II Factory and SILworX

HIMatrix controllers can either be programmed with ELOP II Factory or with SILworX, if the appropriate version for the operating system is installed. The combinations of programming tool and operating system version are specified in the table.

Operating system	Version for ELOP II Factory	Version for SILworX
Processor system	Versions prior to 7	Versions beyond 7
Communication system	Versions prior to 12	Versions beyond 12
OS loader	Versions prior to 7	Versions beyond 7

Table 4:   Operating System Versions and Programming Tools

5.3.3.1 Upgrading from ELOP II Factory to SILworX

This upgrade may only be used for HIMatrix controllers and remote I/Os with newer layouts. Any attempt to use it with controllers and remote I/Os with previous layouts leads to failures that can only be removed by HIMA.

i
- HIMatrix controllers that can be programmed with SILworX, are only compatible with remote I/Os that can also be programmed with SILworX. For this reason, also ensure that the appropriate remote I/O is used.
- For F60 systems, no upgrade other than that of the processor module is required. The operating system of the processor module determines the programming tool.
- The user program cannot be converted from ELOP II Factory to SILworX and vice-versa.
- Please contact HIMA service if it is not clear whether a given controller or remote I/O may be upgraded.

Update the operating system loader (OSL) when performing an upgrade.

To prepare a HIMatrix controller for being programmed with SILworX

1. Use ELOP II Factory to load the processor operating system into the controller, versions beyond 7.
2. Use ELOP II Factory to load the communication operating system into the controller, version beyond 12.
3. Use SILworX to load the OSL into the controller, versions beyond 7.

The controller must be programmed with SILworX.

5.3.3.2   Downgrading from SILworX to ELOP II Factory

In rare cases, it can be necessary changing a controller or remote I/O to be programmed using ELOP II Factory instead of SILworX.

To prepare a HIMatrix controller for being programmed with ELOP II Factory

1. Use SILworX to load the OSL into the controller, version prior to 7.
2. Use SILworX to load the processor operating system into the controller, for CPU versions prior to 7.
3. Use SILworX to load the communication operating system into the controller, for COM versions prior to 12.

The controller must be programmed with ELOP II Factory.

Appendix

Index of Figures

Index of Tables

HIMA SAFETY NONSTOP

(1037)

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